

GIANT PLANAR HALL EFFECT IN EPITAXIAL FERROMAGNETIC SEMICONDUCTOR DEVICES

ABSTRACT OF THE DISCLOSURE

Ferromagnetic semiconductor-based compositions, systems and methods that enable studies of the dynamics and magnetoresistance of individual magnetic domain walls, and which provide enhanced magnetic switching effects relative to metallic ferromagnets. Aspects of the present invention are enabled by recent studies of the Giant Planar Hall effect (GPHE), and in particular GPHE in (Ga,Mn)As - based devices. The GPHE generally originates from macro- and micromagnetic phenomena involving single domain reversals. The GPHE-induced resistance change in multiterminal, micron-scale structures patterned from (Ga,Mn)As can be as large as about 100Ω , four orders of magnitude greater than analogous effects previously observed in metallic ferromagnets. Accordingly, recent data provide sufficient resolution to enable real-time observations of the nucleation and field-induced propagation of individual magnetic domain walls within such monocrystalline devices. The magnitude of the GPHE is generally size-independent down to the submicron scale indicating that for applications involving nanostructures it is capable of sensitivity comparable to SQUID-based techniques.

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